Using 5-meter data from ARGC in ArcGIS and Autodesk Land Desktop

By Nathaniel Todea

5-meter DEMs are available from Utah Automated Geographic Reference Center (AGRC) http://gis.utah.gov/images/sgidraster/DEM_5m_areas.html. In the near future with the installation of ArcGIS 9.2, DEM data will be available and downloadable from ARGC web server. Unfortunately the DEMs are not the type of DEMs that are accessible in AutoCad. Below are procedures to bring DEM data into AutoCad using ArcMap ArcInfo. *Note: you will need to have the full version of ArcMap ArcInfo, not Toolkit ArcMap-ArcEditor for the below procedures to work properly*. If you have ArcMap 8.3 ArcEditor the procedures will not work. This user guide outlines several process for working with elevation data, which may not be needed depending on the project. Refer to the table of contents below.

TABLE OF CONTENTS:

Note: 5-meter DEMs does not substitute good sound engineering and the need for surveying.
Below is the information, tolerances and limitation of data.

Accuracy of Products:

Product	Horizontal	Vertical
2-meter DEM from 12.5 cm HRO (6 inch)	NSSDA, radial RMSE of 2.2', 95% confidence 3.8'	2.13' RMSE NSSDA 95% 4.2'
2-meter DEM from 25 cm HRO (1 foot)	NSSDA, radial RMSE of 4.4', 95% confidence 7.6'	4.27' RMSE NSSDA 95% 8.4'
5-meter DEM from 1-m NAIP	RMSE 3m, NSSDA 95% of 5.2m	RMSE 4m, NSSDA 95% of 9.8m

Datum / Coordinate Specification

Project Coordinate Specifications	
Horizontal Datum	NAD 83
Vertical Datum	NAVD 88
Coordinate System	UTM Zone 12
Mapping Units	Meter
Geoid Model	Geoid03

DEFINITIONS AND ACRONYMS:

Datum – Defines the size and shape of the earth, and the origin and orientation of the coordinate system used to map the earth.

DEM – Digital Elevation Model

Geoid – The earth has a highly irregular and constantly changing surface. Geoids are gravity models that are used to represent local variations in gravity that change the local definition of a level surface.

HRO – High Resolution Ortho-Photography (1-foot – 6-foot resolution)

NAVD – North American Vertical Datum

NSSDA – National Standard for Spatial Data Accuracy

RMSE – Root Mean Square Error

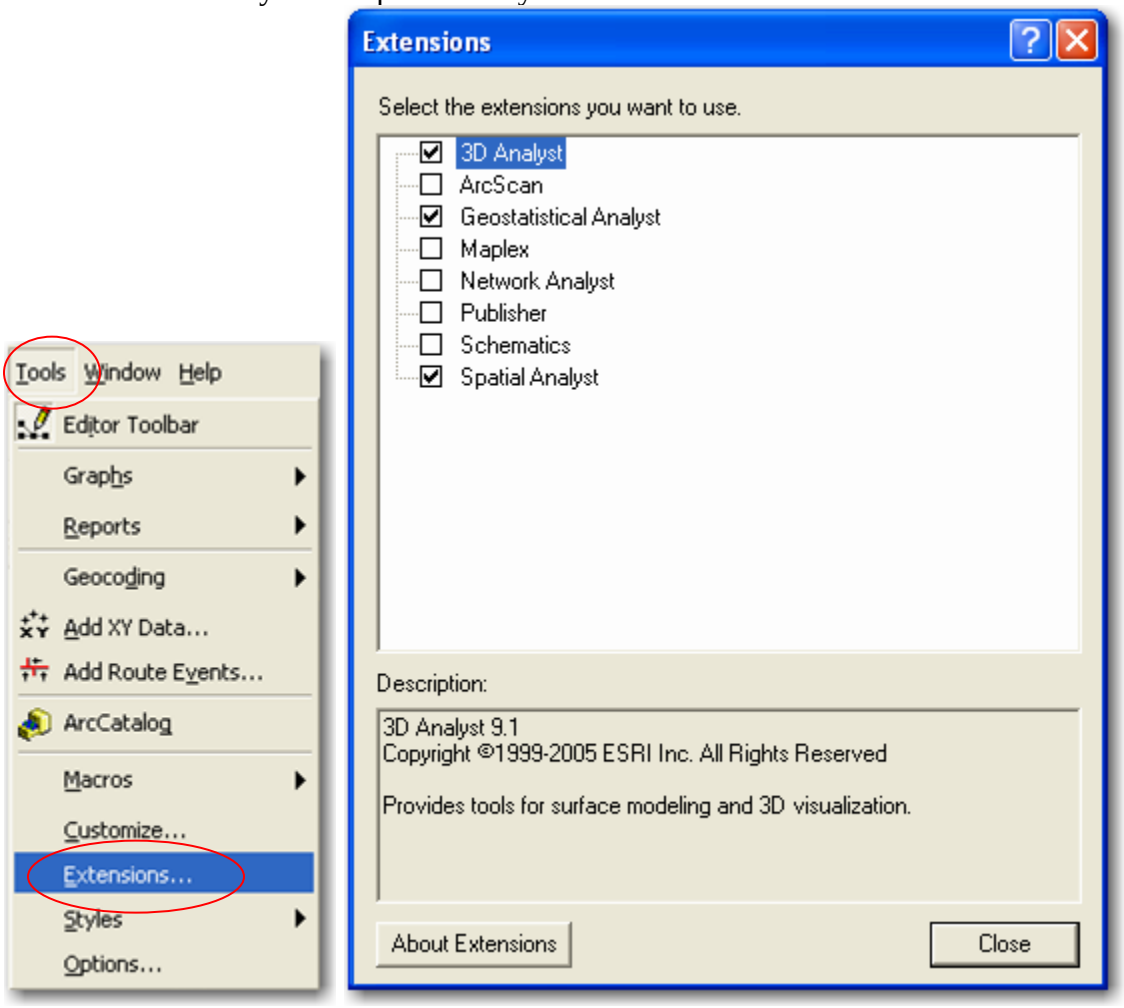
UTM – Universal Transverse Mercator

CONVERTING ASCII FILE TO DEM FOR AUTODESK:
After downloading data from ARGC open ArcMap-ArcInfo. ***HINT****: when saving data do not save data on your desktop. ArcGIS does not like to work with Raster data when the file hierarchy has spaces (C:\dem (good); c:\my project is here (bad))*

Make sure that in the top left blue portion of the screen reads:

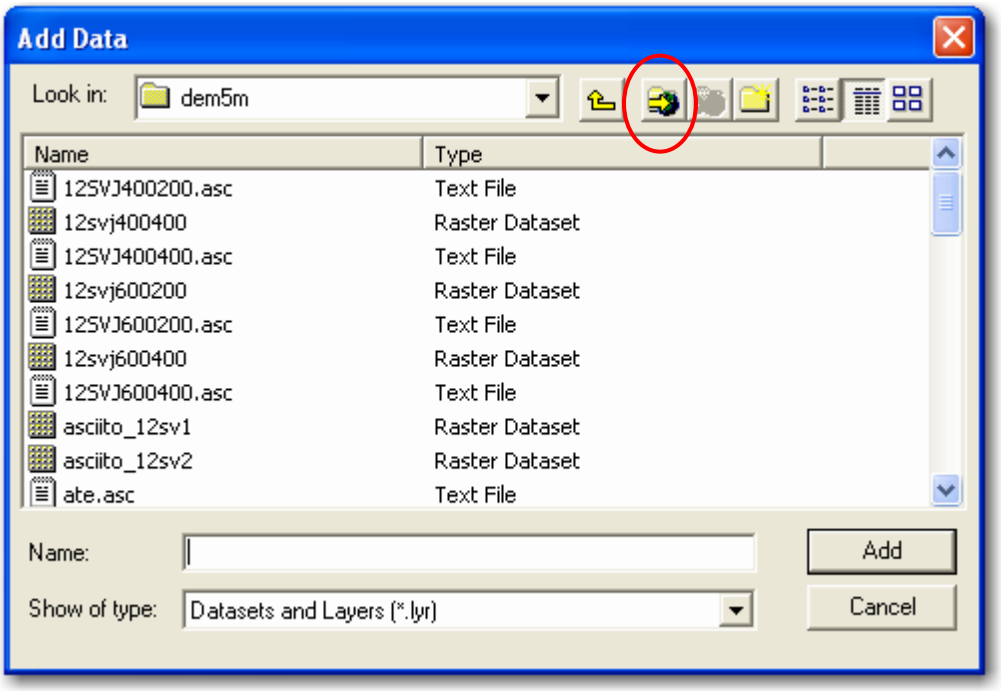
Activate Spatial Analyst and 3D analyst.

Make sure that 3D analyst and Spatial Analyst extensions are on. Select >>Tools>>Extensions then check 3D Analyst and Spatial Analyst

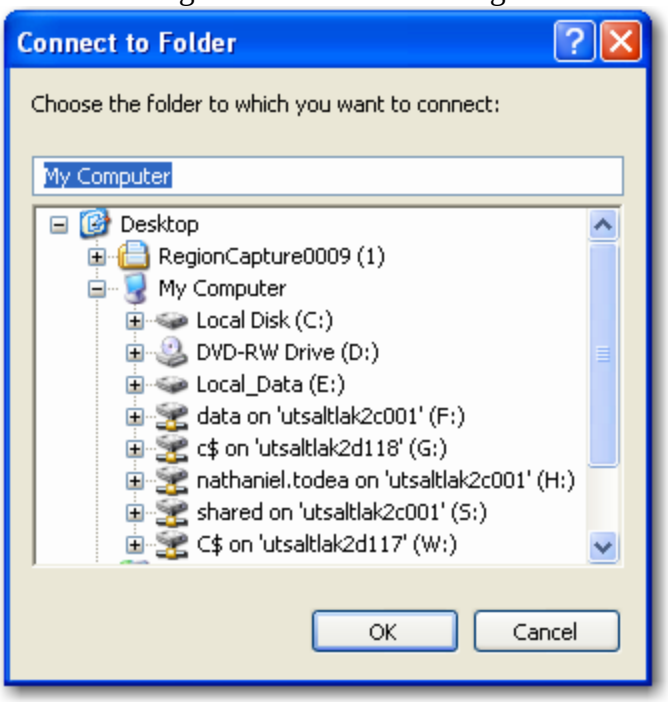


Connecting Folder

In order to connect to folders you need to "Connect to Folder". Located from the "Add Data" (plus button) dialog box or in ArcCatalog you will notice a "Connect to Folder" button  .

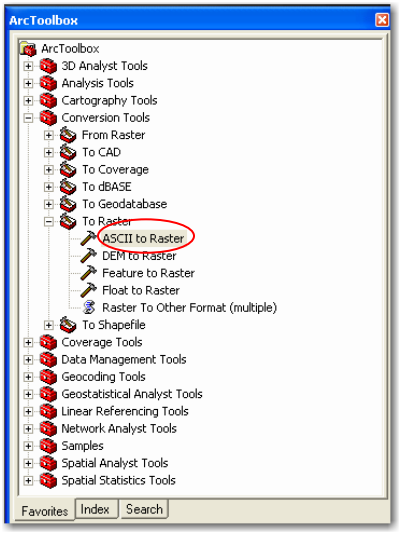


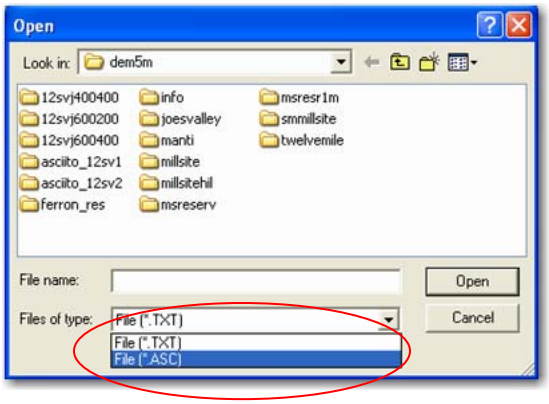
Select this button and you can map to folders that are needed. This will be a one time thing to any folder that you need. After you click the button simply select the folder you want to have access to or link to a folder. Select the drive and click "OK" and then navigate to the folder location through the "Add Data" dialog box.



Open ASCII file and converting to GRID

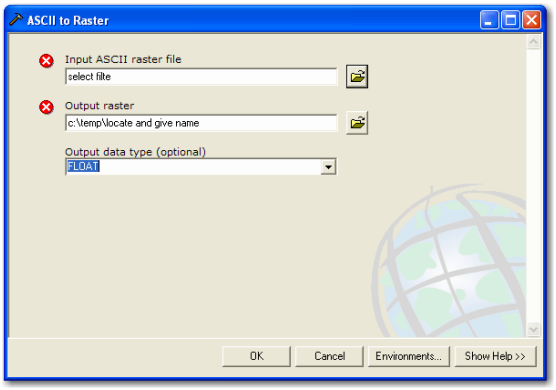
In ArcGIS open Toolbox  . *If this toolbox option is not displayed complete the following >>Tools>>Extension>>Toolbars>>Standard. You can also right click or double left click the black area where the toolbars dock and check Standard*. With the tool box open select >>ArcToolbox >>Conversion Tools >> To Raster>>ASCII to Raster.





If you can not find the file with ASC extension make sure to change file type to File (*.ASC)

Select the appropriate Input ASCII raster file, locate and give an output raster name, select FLOAT.

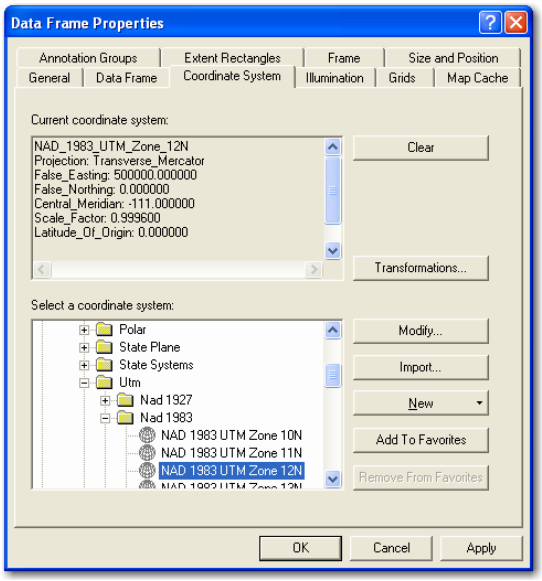


Click “OK”

Setting Projection

Although we know that the file is in UTM NAD 83 meters NAVD88 meters (x, y, z), the computers does not know what the projection datum to be used. Right click on 

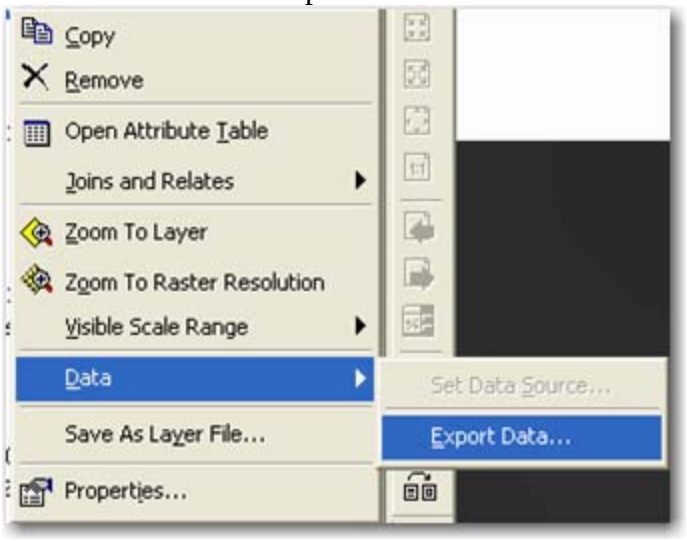
select Properties. At this point you will set projection so that at a later time you can change the units. Select the Coordinate System tab and choose >>Predefined>>Projected Coordinate System>>UTM>>NAD 1983>>NAD 1983 UTM Zone 12N.



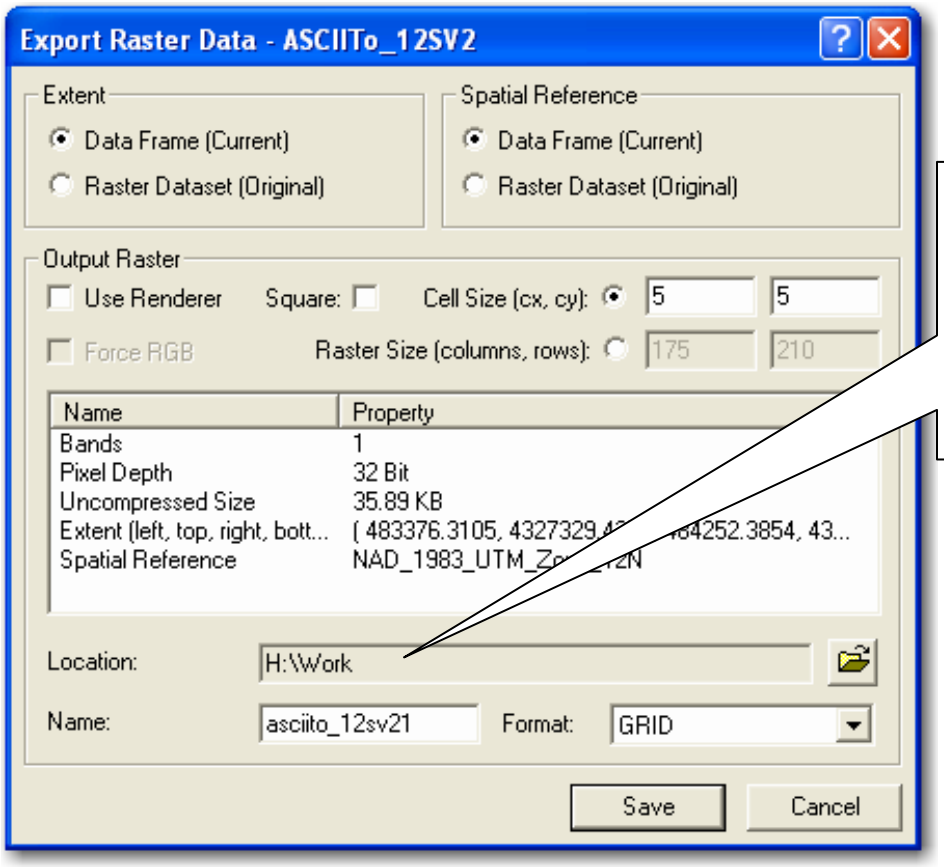
Clipping Area of Interest

Select the area of interest you would like to work with. Select the Zoom In option  on the Tools Toolbar 

On the Grid file that you just created right click on that file name in the Table of Contents and select >>Data>>Export Data



Click Data Frame (Current) in Extent and Spatial Reference, locate and name the file. ***Note**: To select a folder to save in, click the folder icon. Only select the folder to save in. Name the file in the "Name" field. ** **Hint**: Raster files do not like spaces, folder, file or path name, do not like numeric first character, and do not like file name to be greater than 13 characters.*



Remember you are only placing, not creating file. That is, click on folder you want data to be stored then click "Add"

Click "Save" to export.

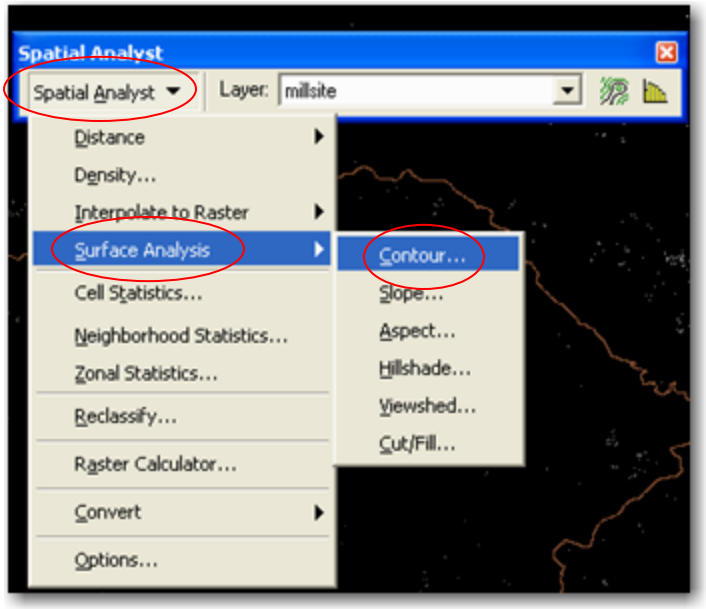
***Note**: New data has projection and datum and knows what units it is in.*

Since you clipped the data to an area of interest the file is manageable. The file is no longer a 12 mile by 12 mile area.

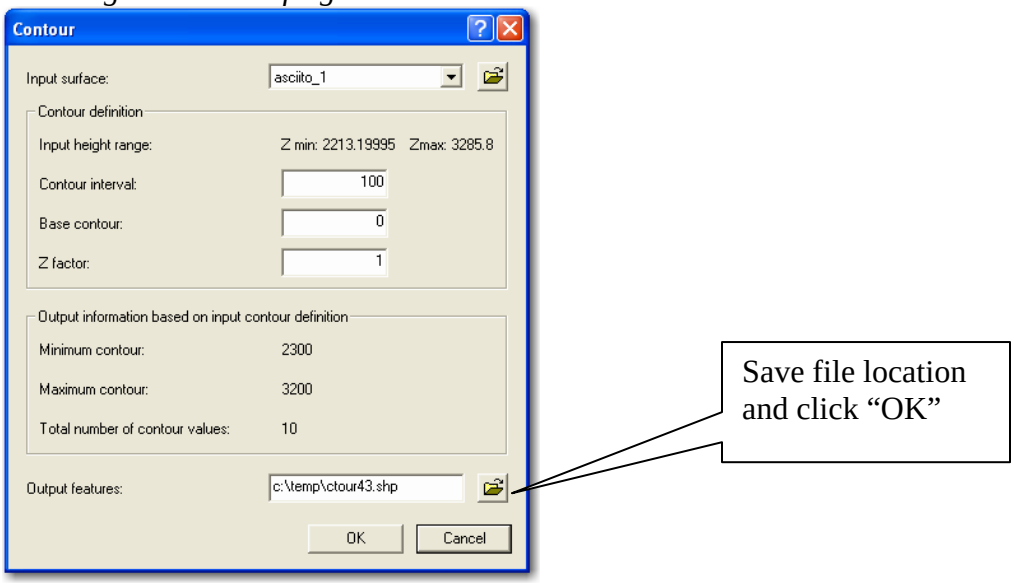
Creating Contours

Right click tan area and select Spatial Analyst or select >>Tools>>Customize >>Toolbars>>Spatial Analyst.

To create contours select Spatial Analyst>>Surface Analyst>>Contours. . .

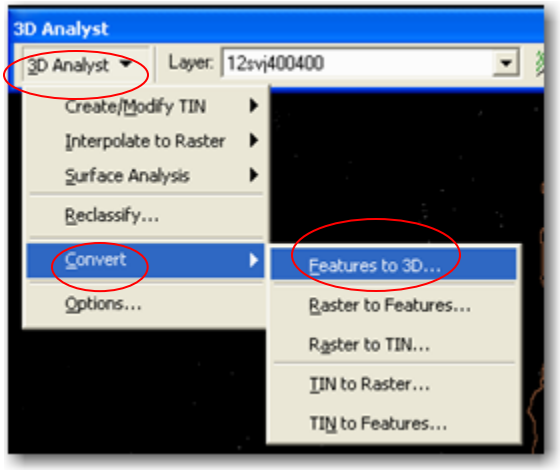


With the Contour window open locate the file where the contours will be derived, name, and location of the file to be created and set contour interval. ***Note***: *I strongly suggest that a one meter interval be set at a minimum. Also if there is a lot of relief the contour interval can be much higher. Do not forget the more contours the more data intensive.*

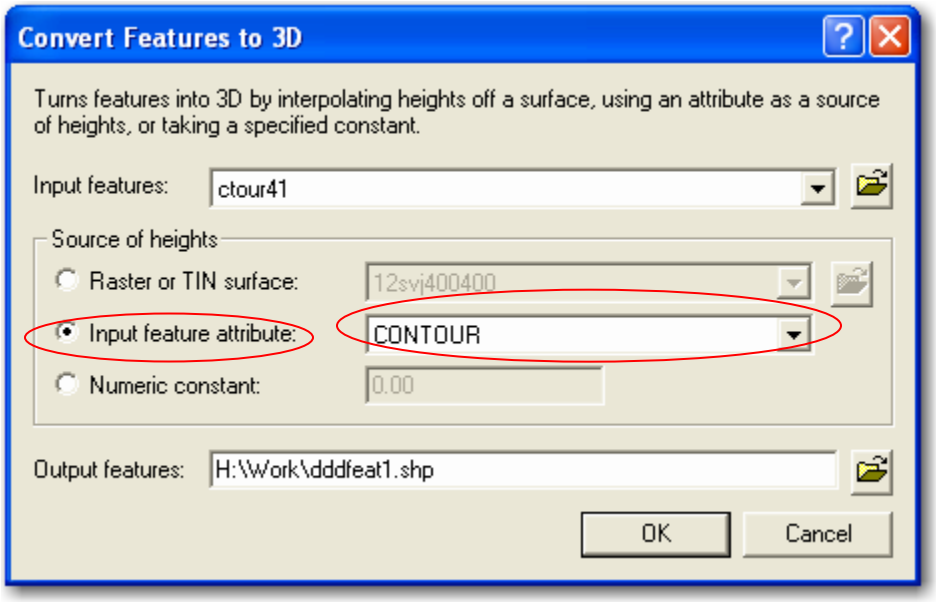


Create 3D polyline.

With the 3D analyst toolbar (Right click or double click the empty area where the toolbars dock and select 3DAnalyst or select >>Tools>>Customize >>Toolbars>>3D Analyst) click the 3D Analyst dropdown>>highlight “Convert” >>click “Features to 3D” .



Select file to be converted, select >>Input feature attribute>> “CONTOUR”, and name and locate file.



You are now done with ArcMap.

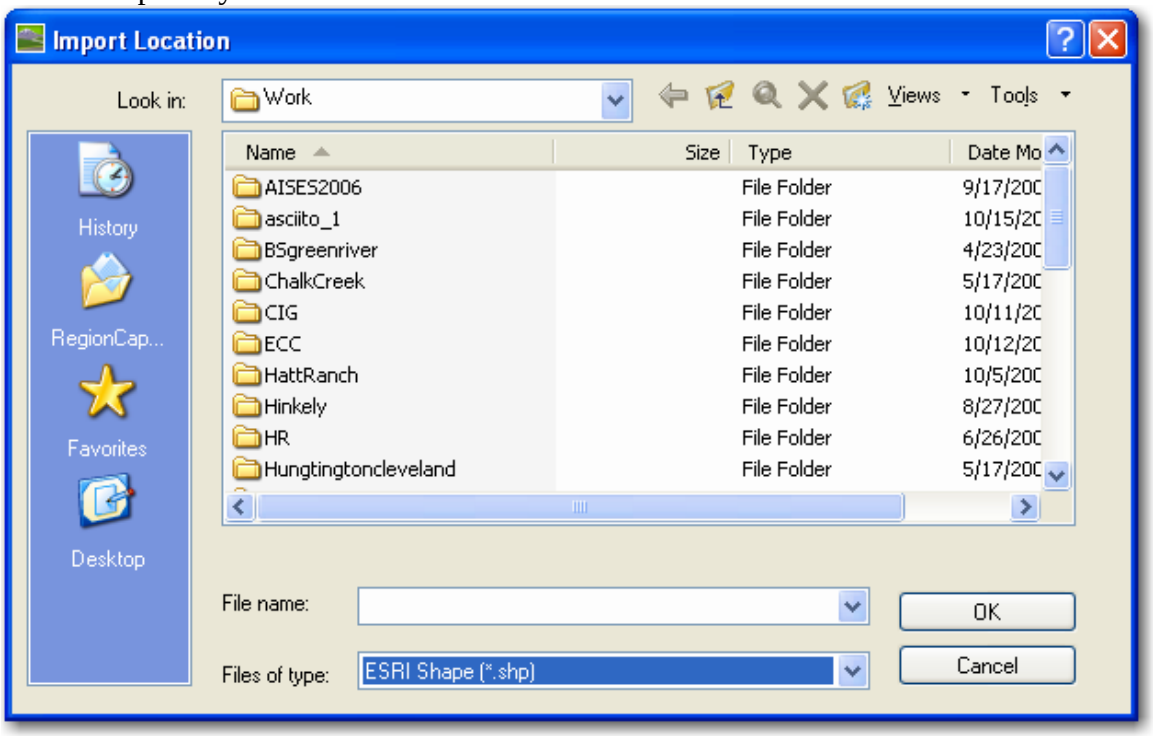
Open file in AutoCad.

Using AutoDesk Land Desktop 2007 

the 3D shapefile will be open and the file will be converted from a polyline to contours to save compute space. Create project, designate paths, and file names just like any other AutoDesk protocol. Open Map 

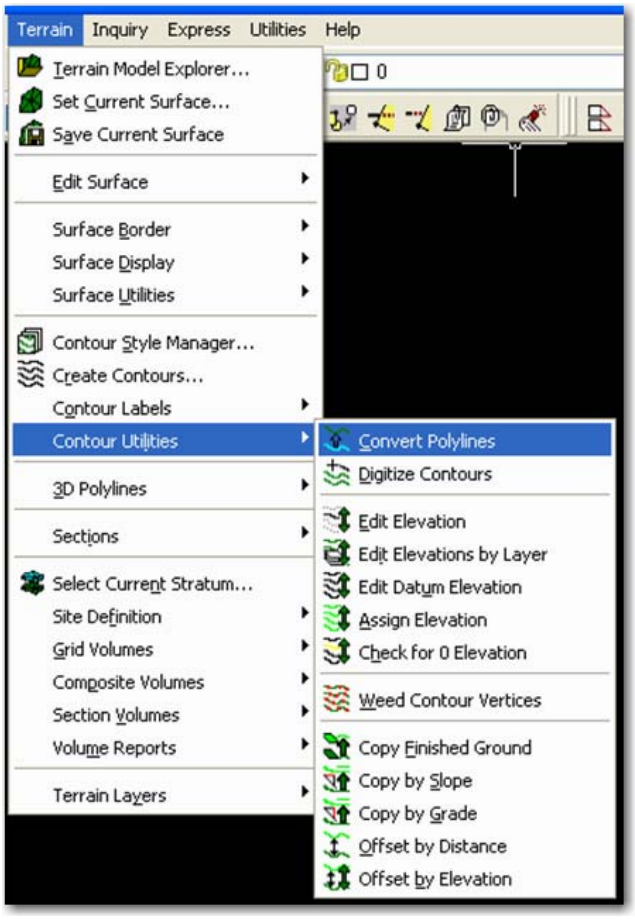
and select the Import Map File. Select

the 3D shapefile you created in ArcGIS



Next screen select okay

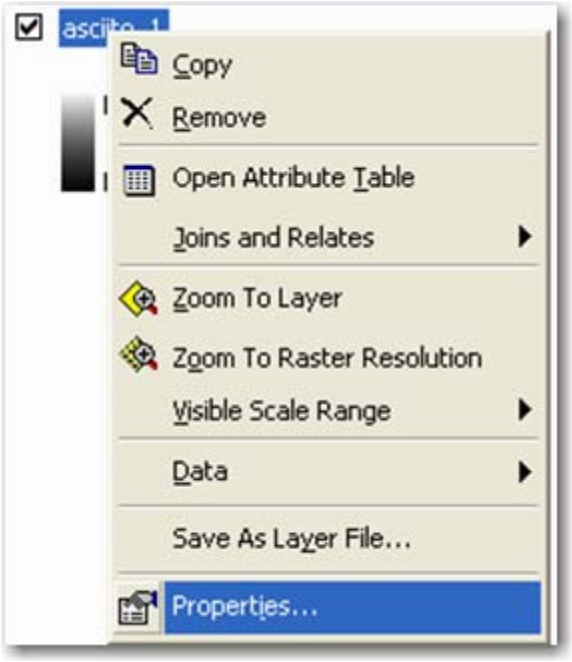
Using Terrain pull down select >>Contour Utilities>>Convert from Polylines. Select lines you want to convert and hit enter.

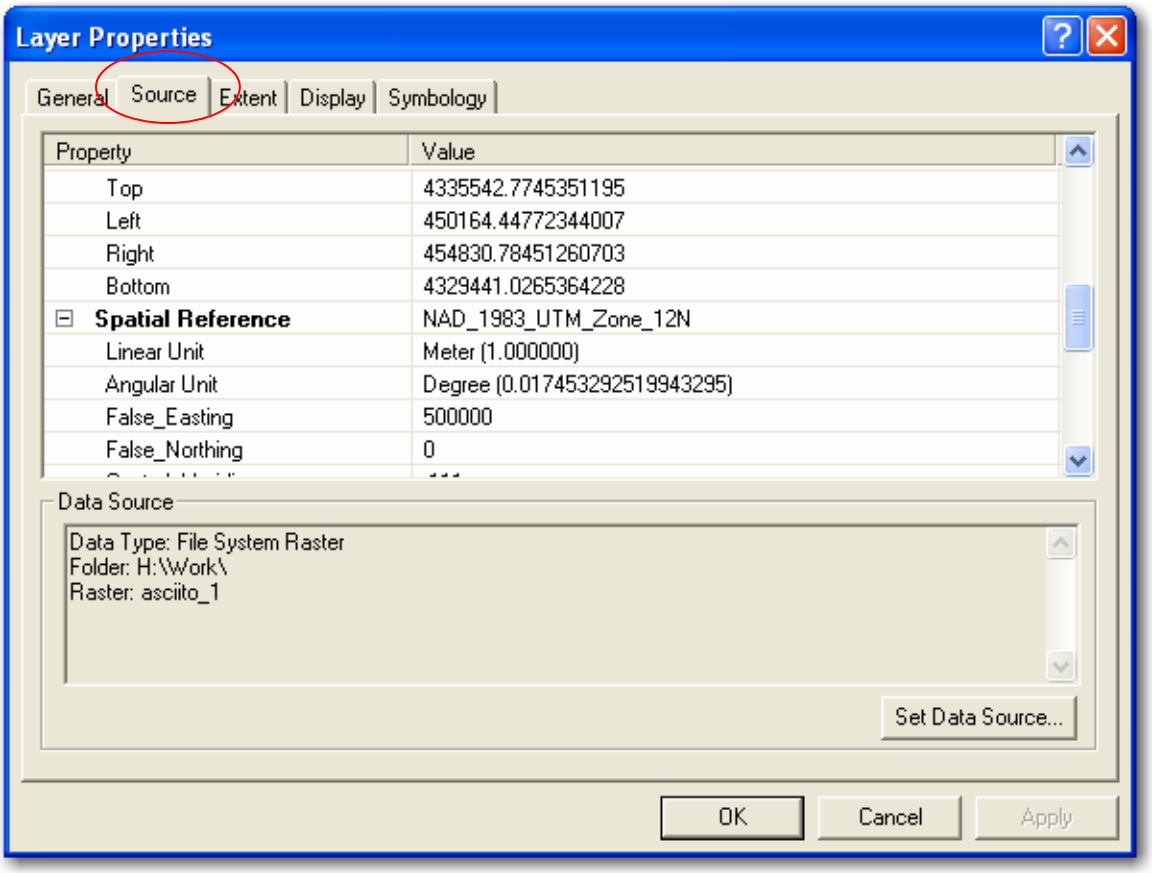


OTHER TOPIC *BRING DATA IN FEET (X), FEET(Y), AND FEET (Z)* OR WHAT I CALL *UTM FEET X,Y,Z*

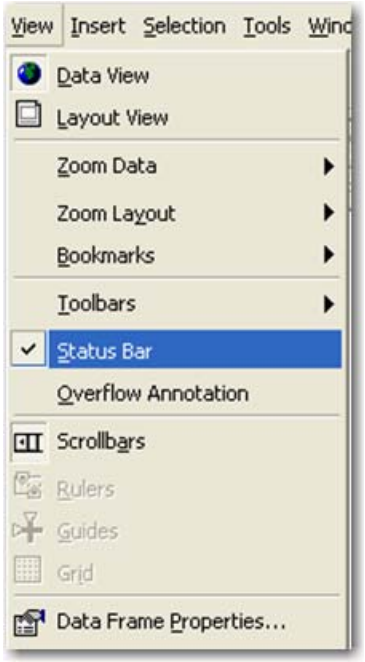
Option 1:

Since your file already had project UTM meter (x,y,z). Start a new project. Add your clipped DEM with projection. You can make sure by right clicking the file and checking properties and looking under the "Source" tab.



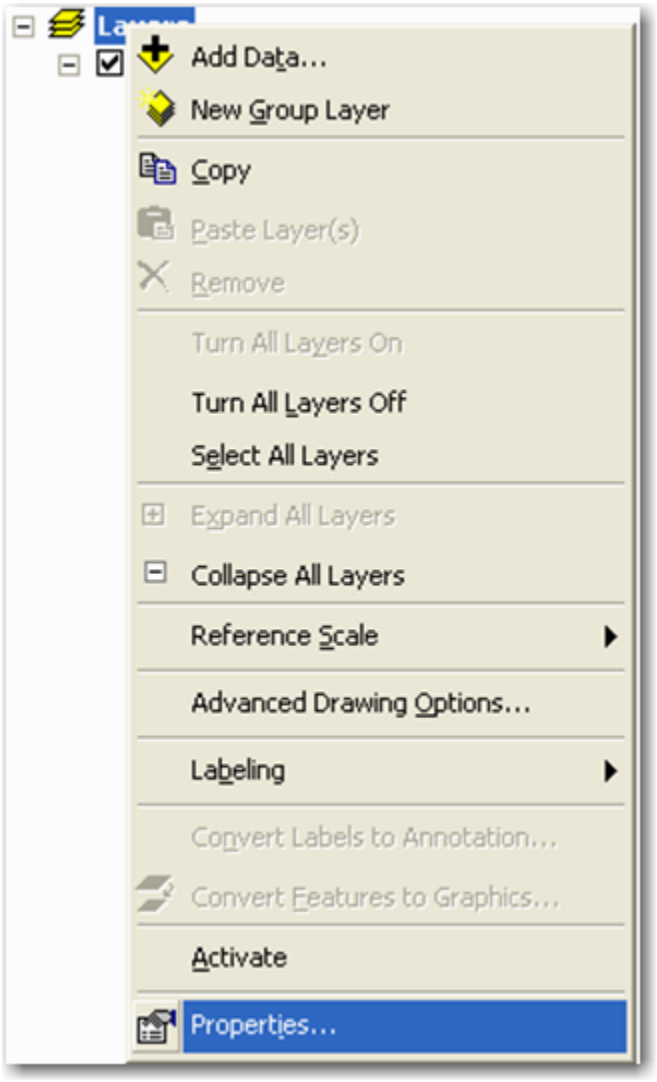


Since we now know that it has projection, we can change the screen projection. ***Note****: Utah UTM coordinate system (x,y-meter) is around 400,000 (x), and 4,000,000 (y) and when it is in feet it is around 1.4 million and 14 million.* To verify it is in meters or feet look at the lower right corner of the screen. If nothing appears while moving the mouse in the data view area select >>View (pull-down)>>Status Bar.

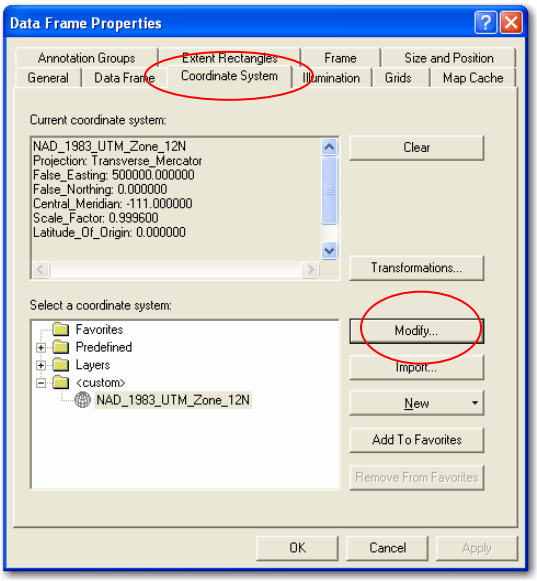


Now that you verified what the units are, right click the “Layers” Data Frame 

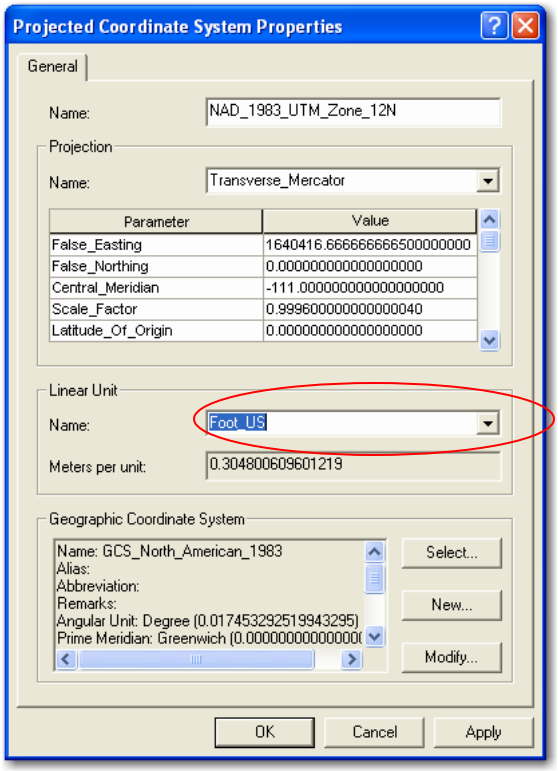
and click “Properties”



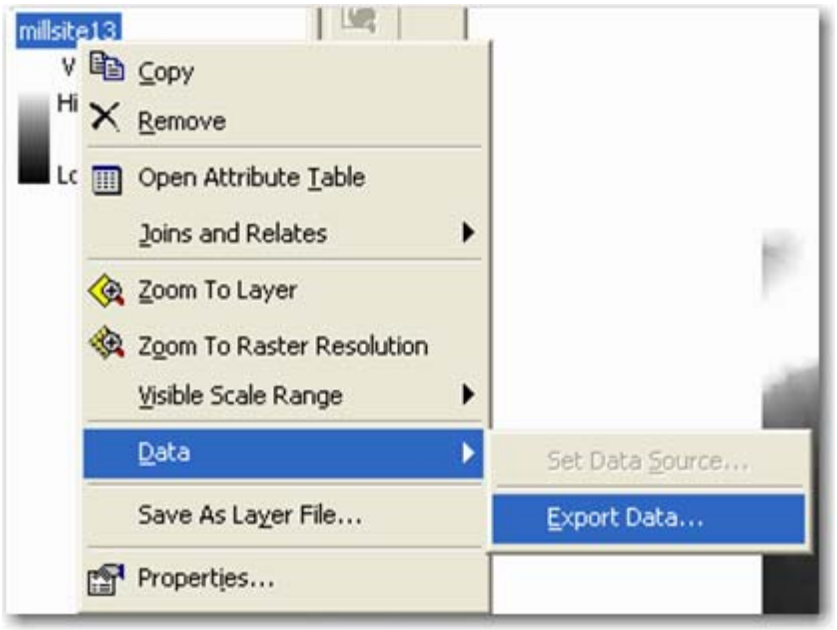
With “Properties” open select the >>Coordinate Systems Tab<<



You will notice that your <custom> option defaults to NAD_1983_UTM_Zone12N since the file that is open has a projection. Click the "Modify" option and change to Foot US, since you want feet, feet, feet. This will cover the "x" and "y" and the steps below will cover the "z."

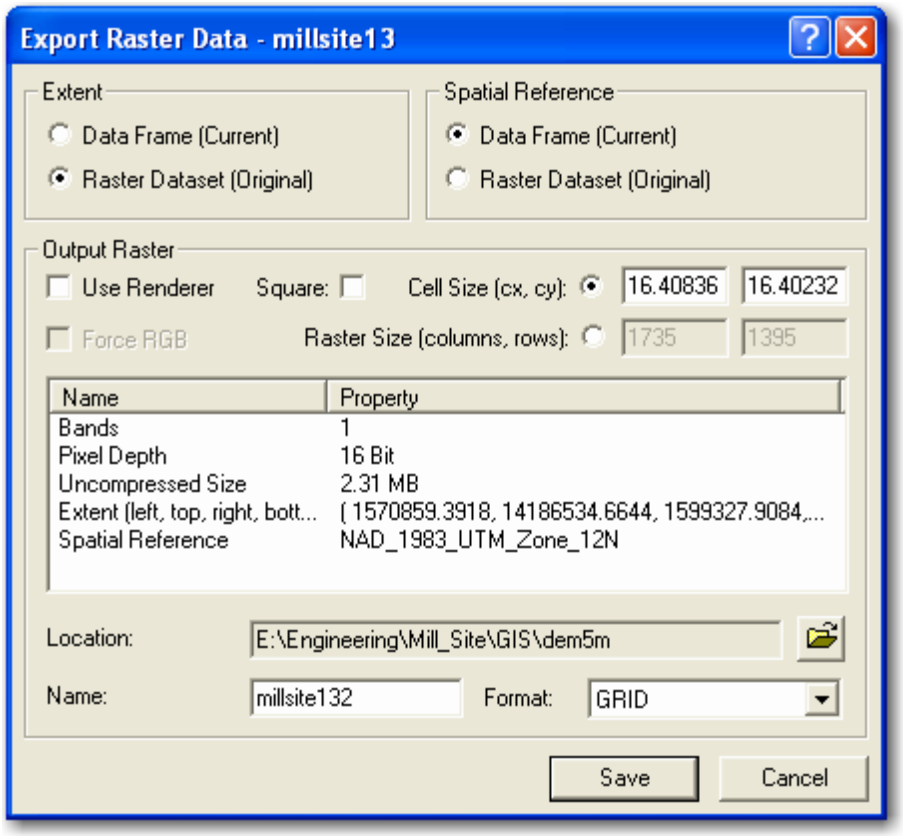


Export data again since the file projection will be converted to existing spatial reference.



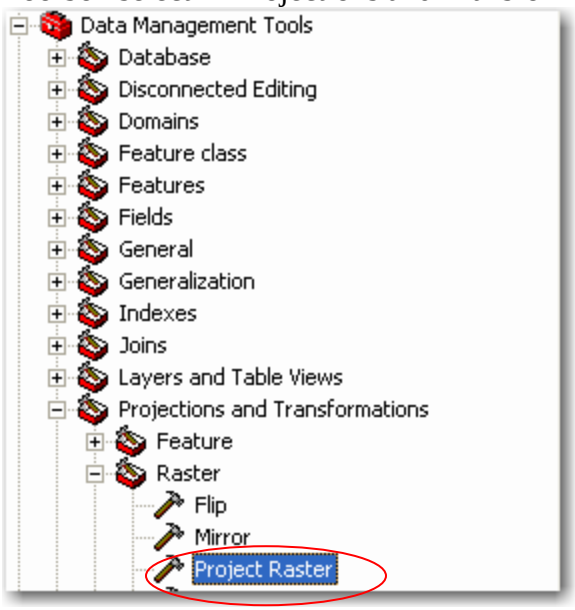
Keeping your file names straight at this point is critical. You might use "UTM-ft" in the name somewhere so that you can recall the different units. You might also want to have two

projections one in UTM meter and one in feet. Make sure you use the current Data Frame (Spatial Reference). Note the program already converted the 5 meter grids to units of feet.

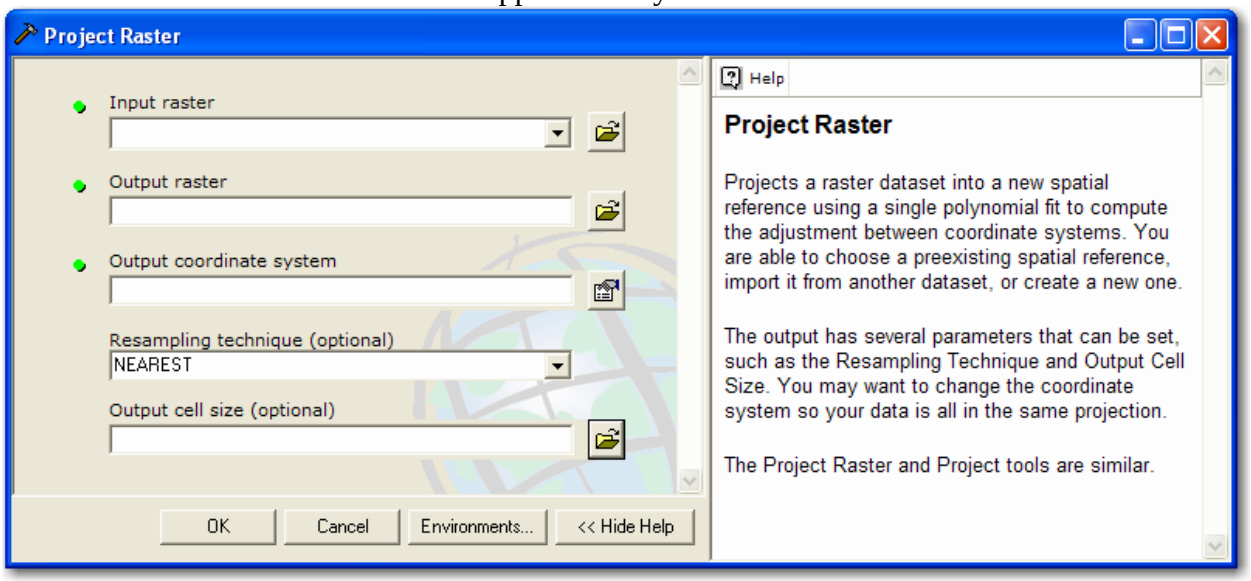


Option 2:

Alternatively to this method you can also use ArcToolbox. Under Data Management Tools in Toolbox select >>Projections and Transformations>>Project Raster.

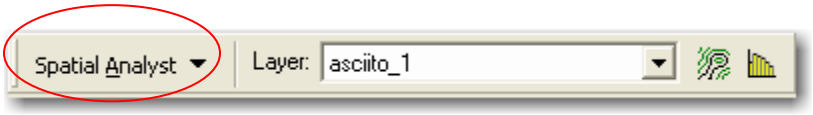


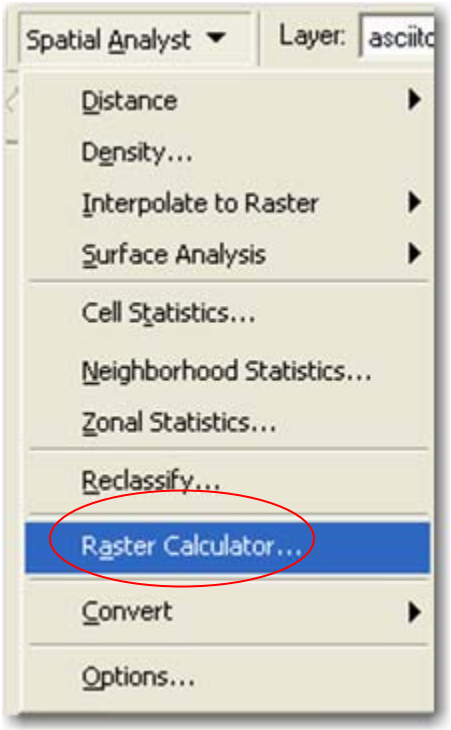
Fill in the fields with green dots next to them. You will notice the program will also convert units in the cell size from 5 meters to approximately 16 feet.



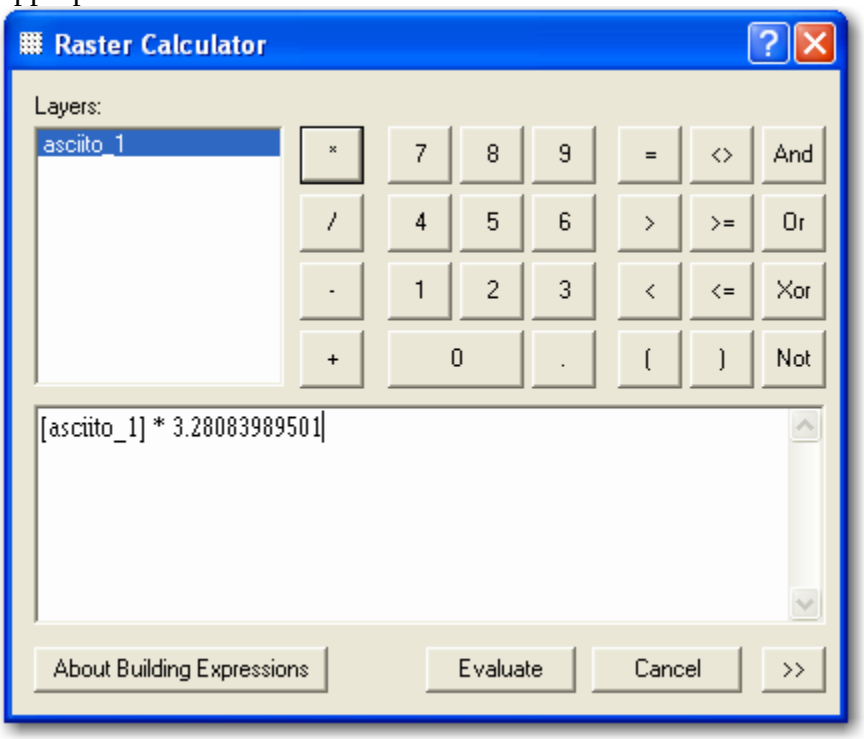
You will notice that in the lower right area of the screen that units are in feet and are in the range of 1.4 and 14 million, a good check.

To convert the "Z" click the "Spatial Analyst" menu and select "Raster Calculator"

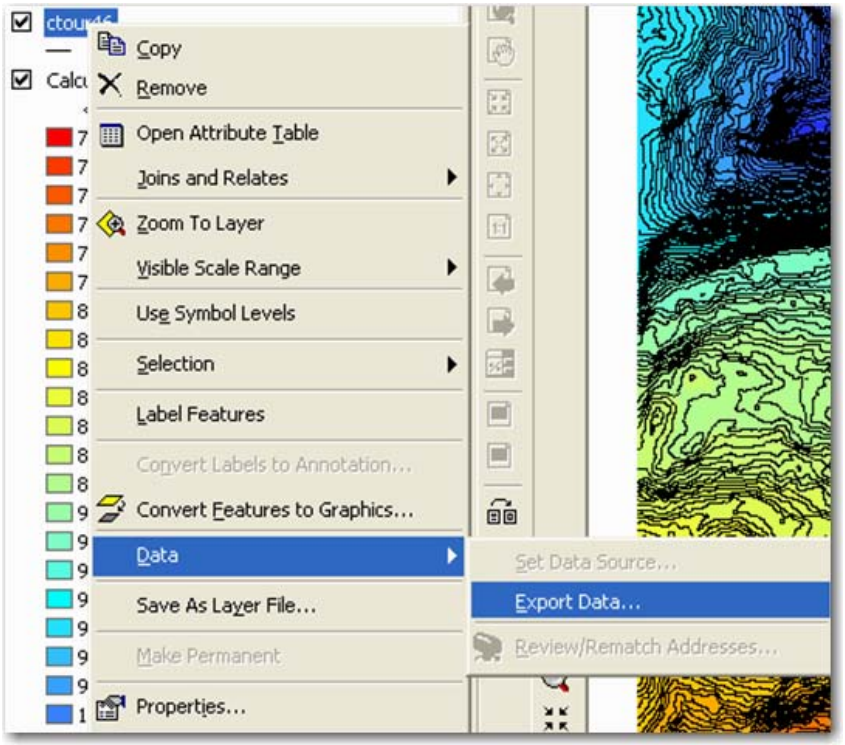




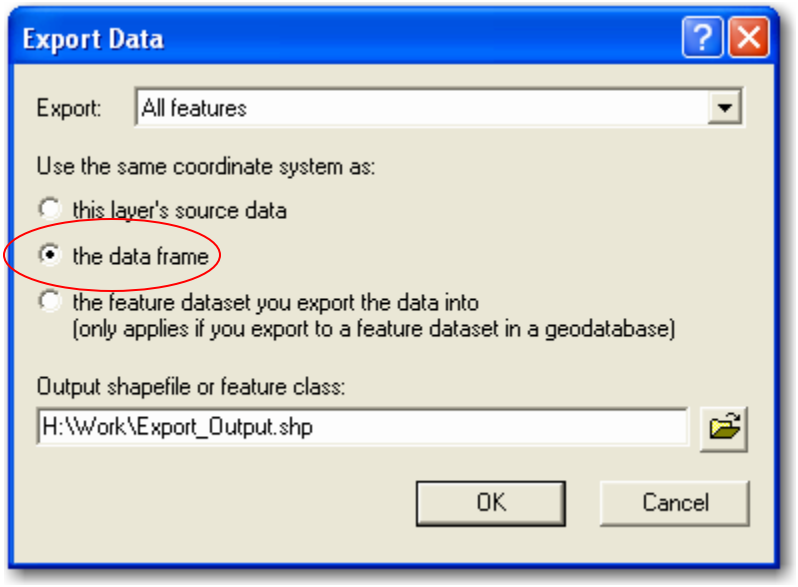
In the Raster Calculator expression box select the clip grid (layer) and multiply or divide by the appropriate conversion factor.



Now you can create contours in feet rather than meters (see previous pages for procedures) and export selection. After making your contours select the shapefile and right click >>Data>>Export Data

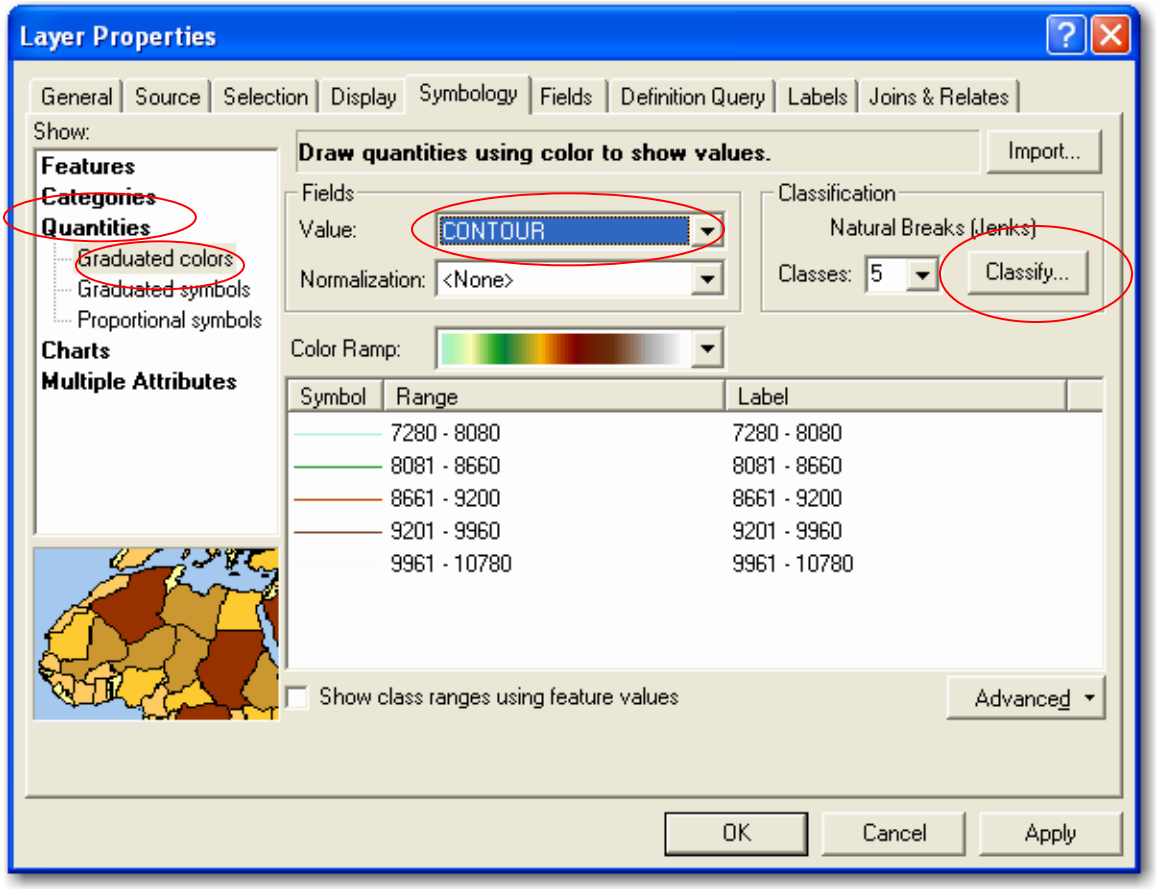


Make sure to set the file location and also make sure to select the >>the data frame<< option. Follow the previous covert to 3D procedures.

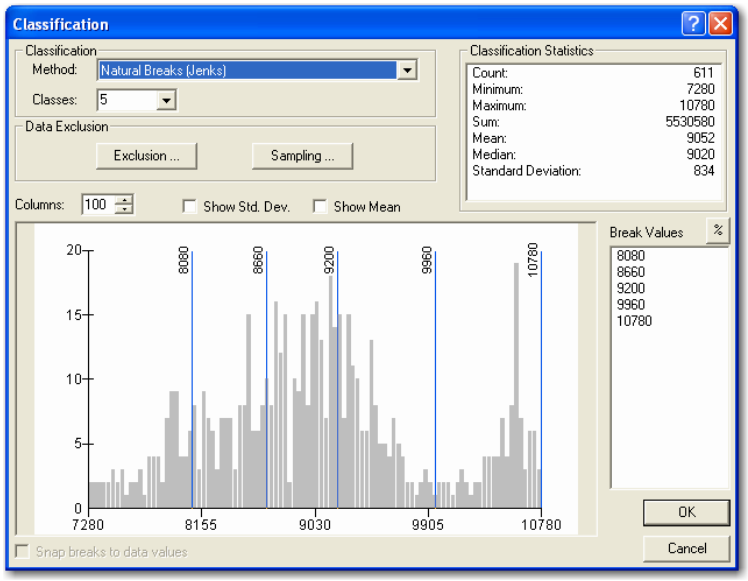


FILE IS TOO BIG AND MAKES MY AUTODESK CRASH.

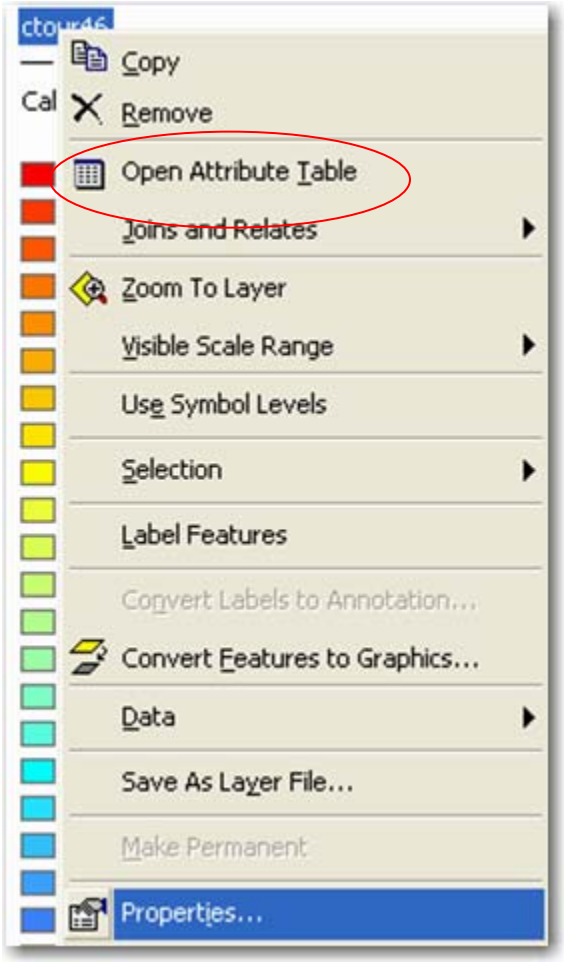
Remember if you have a lot of relief you might want to change contour interval. You can also select the contours you want. You can narrow down your selection of contours you want by attribute. In this case you might want to only look at low elevation data. You need to be familiar with your data set. To become more familiar with the data set not your min and max elevation you can also go into your symbology (>>Quantities>> Graduated colors>>and click "Classify" to get a histogram of your data.



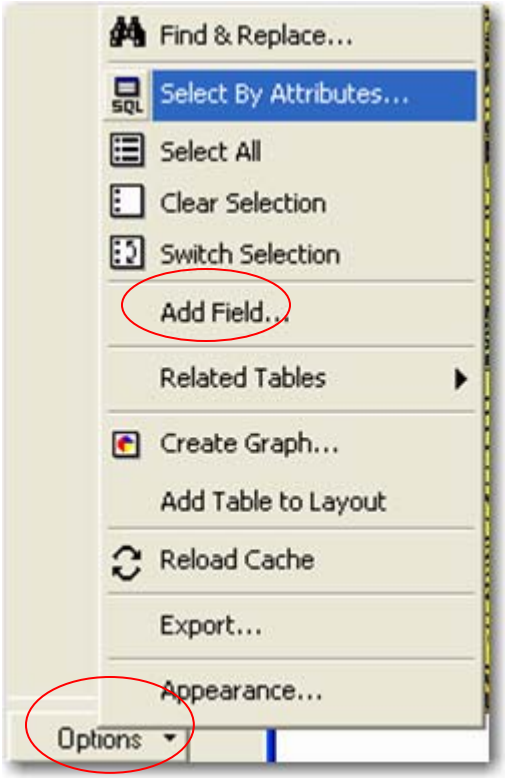
When viewing your data you can set the statistics and distribution of data.



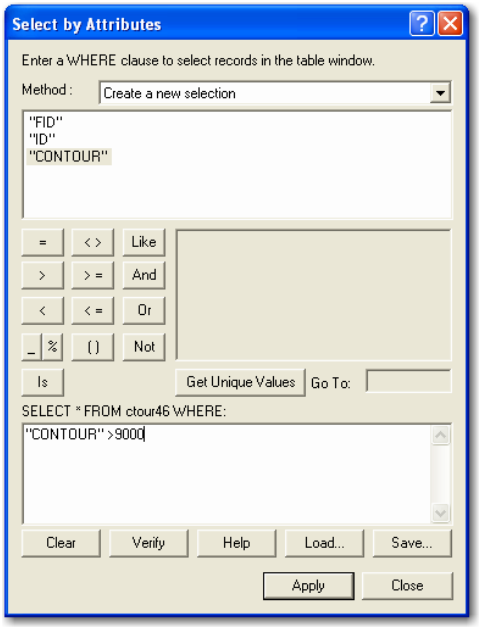
After becoming familiar with your data you can start working on filtering data. So, right click on the contour layer you created and click “Open Attribute Table”.



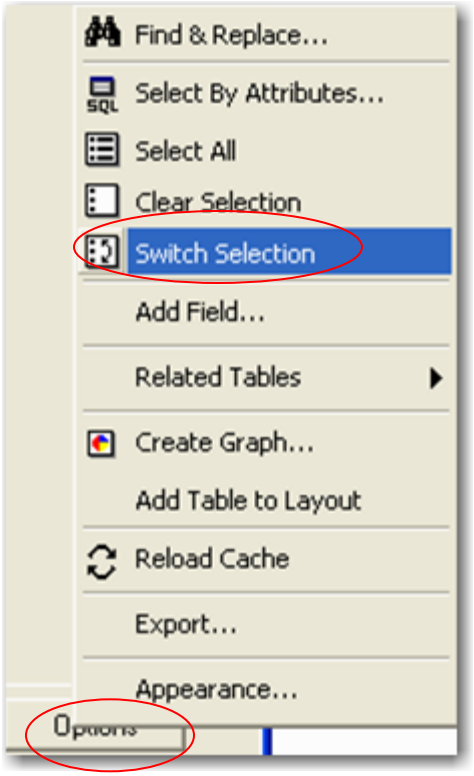
With the attribute table open select the “Options” button (lower right) and click “Select By Attributes”



At this point write your expression and click “Apply”.



If you wanted the less than or greater symbol but liked your split value click the “Option” button and >>Switch Selection<<. This will of course switch selection.



At this point you export selected data right click on contour layer >>Export Data, choose the Selected Features option.

MERGE OR MOSAIC FILES TO GET COMPLETE COVERAGE

.

Definitions:

Merges multiple input rasters into a single raster based upon order of input

How Merge works

Map Algebra

Merge can be used to spatially append or mosaic rasters of different map extents, however, these have to be in the same coordinate system. The rasters can be totally overlapping, partially overlapping, adjacent, or entirely separated. If the input rasters overlap, the order of precedence is defined by the order of the rasters in the argument list.

When the input rasters overlap, they are viewed as a set of layers where NoData is transparent. The output raster receives the first value at each cell that is not NoData. For a set of overlapping rasters, a number can be entered as valid input, but this input should be the last one in the list, since it will populate the remainder of the raster.

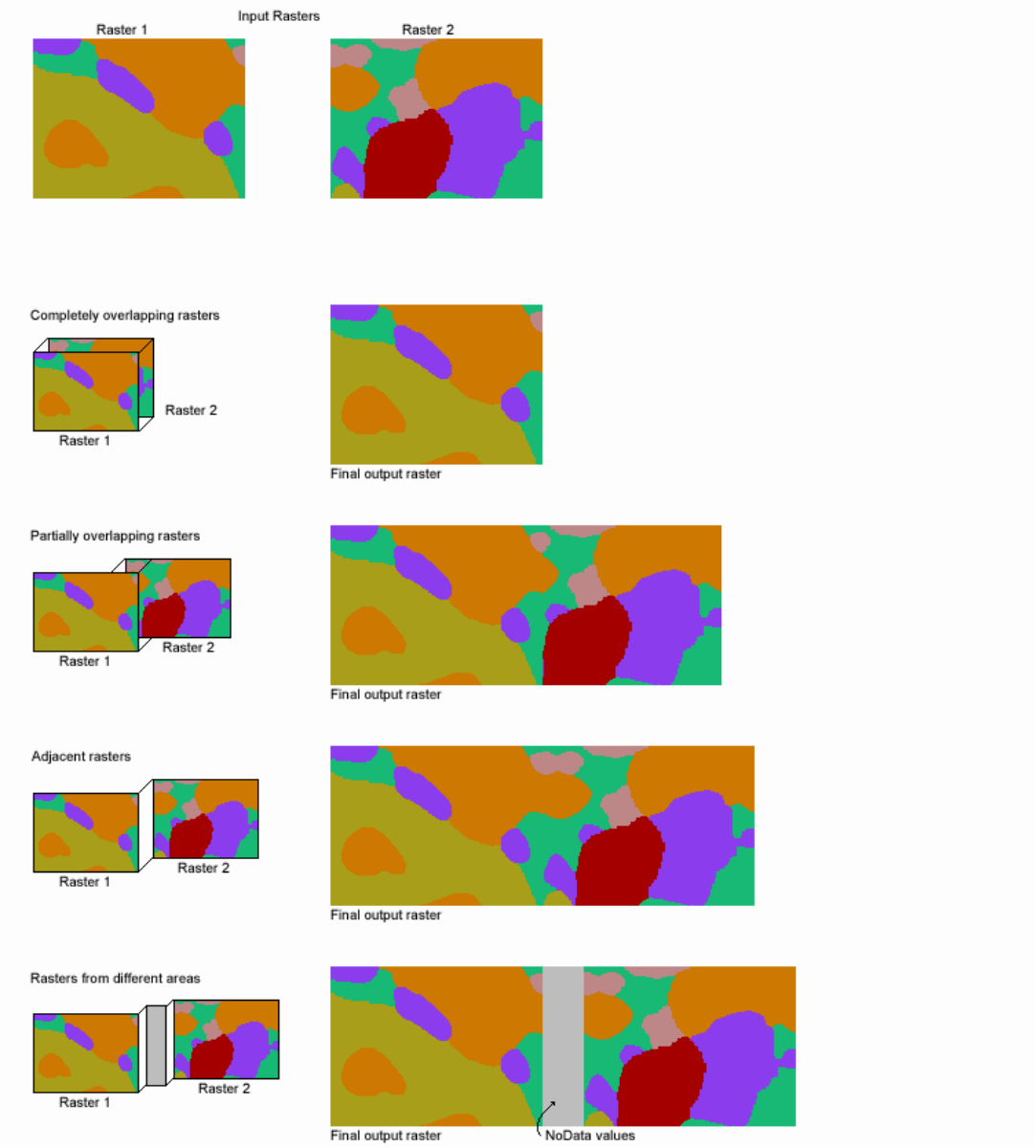
The Merge function itself will not interpolate to fill missing data between adjacent rasters. The following Map Algebra expression may help to solve the problem by interpolating values of the missing cells. It will fill gaps of up to three rows or columns of NoData cells (the length of the gap is unrelated) with the mean cell value of the 4-x-4 square, leaving the valid existing data unchanged. If the gap is wider than three cells, the size of the focal window may be increased.

```
con(isnull(gap_merge), focalmean(gap_merge, rectangle,4,4), gap_merge)
```

If the gap needs to be eliminated from the mosaic made up of categorical rasters, the following approach may be useful:

```
eucallocation(gap_merge)
```

Spatial relationships of rasters to be merged



Mosaics multiple input rasters into a single raster based upon order of input

Spatial Analyst

How Mosaic works

Map Algebra

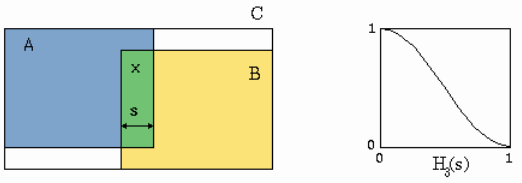
The Mosaic function works similarly to the Merge function. When the rasters to be put together do not have any overlapping area, there is no difference in the output from both functions. The difference is the processing of the overlapping areas. In case of Merge, the sequence of input rasters determines the values assigned to cells over the common map extent, giving priority to those entered first.

For Mosaic, the sequence of entry on the command line is irrelevant if on each overlapping area no more than two rasters intersect. Mosaic uses a weighted average method to calculate values of cells in the overlapping area, taking input from two or more input rasters. The proximity analysis algorithm applied to determine cell values over the overlapping areas is called the Hermite Cubic and can be described by the following formula:

$$H_3(s) = 1 - 3s^2 + 2s^3$$

where, s is the normalized distance (ranging values from 0 to 1) of the width of the overlapping area (it may be oriented horizontally or vertically). The cell values for the output C raster, being the mosaic of rasters A and B (see left diagram below) on the overlapping area (marked x on the diagram) are calculated according to the following formula:

$$C = AH + B(1 - H)$$



The right diagram above shows graphically how the applied weighted average method works on the overlapping area. The ratio of weights of the overlapping rasters changes within the width(s) of the x area.

For the purpose of explanation, each one of the two input rasters used in the Illustration section represents a discrete type of data which, in general, is not applicable for mosaicking. The input rasters have different map extents, one is shifted versus the other for one column, with the five columns being common for both. The one called 'ingrid2' is a floating-point raster while the other one is an integer.

If the input rasters are of the integer type of data, the output raster would also be integer and the values of the output raster would be truncated.

The Mosaic function itself will not interpolate to fill missing data which may occur while putting a set of rasters into one composite entity. The following Map Algebra expression may help to solve the problem by interpolating values of the missing cells. It will fill gaps of up to three rows or columns of NoData cells (the length of the gap is unrelated) with the mean cell value of the 4-x-4 square, leaving the valid existing data unchanged. If the gap is wider than three cells, the size of the focal window may be very conservatively increased.

```
con (isnull(gap_mosaic), focalmean (gap_mosaic, rectangle,4,4), gap_mosaic)
```

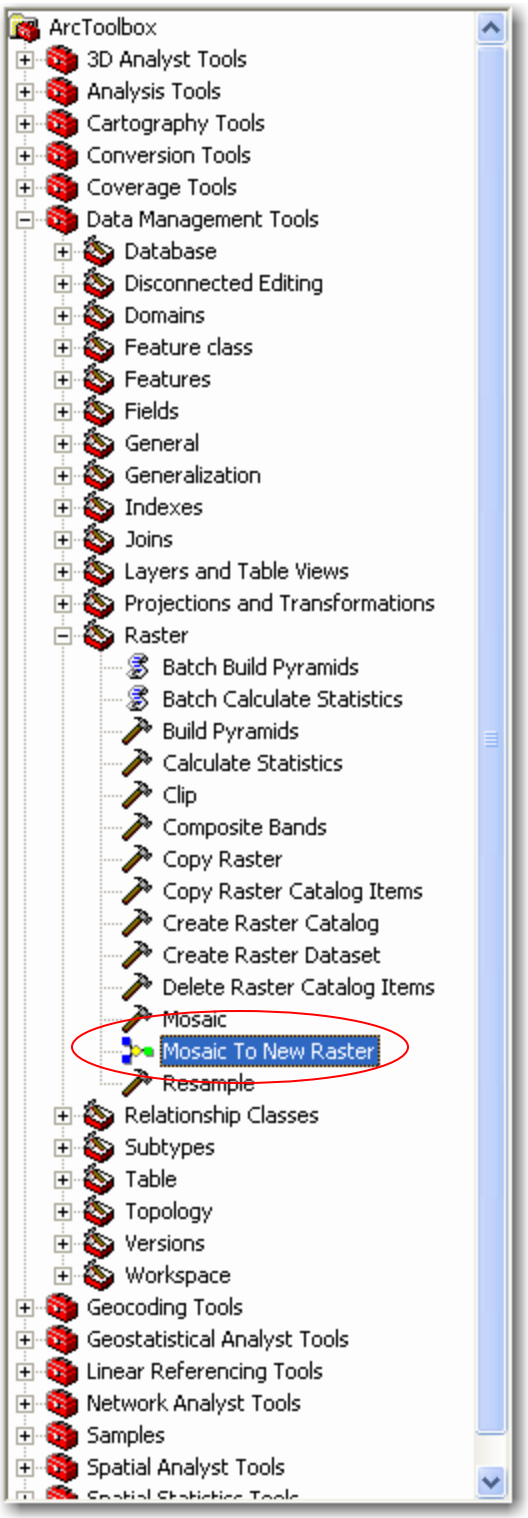
References

Franke, R. (1982). Smooth Interpolation of Scattered Data by Local Thin Plate Splines. Comp. & Maths with Appls. Vol. 8, No. 4, pp. 273-281 Pergamon Press Ltd.

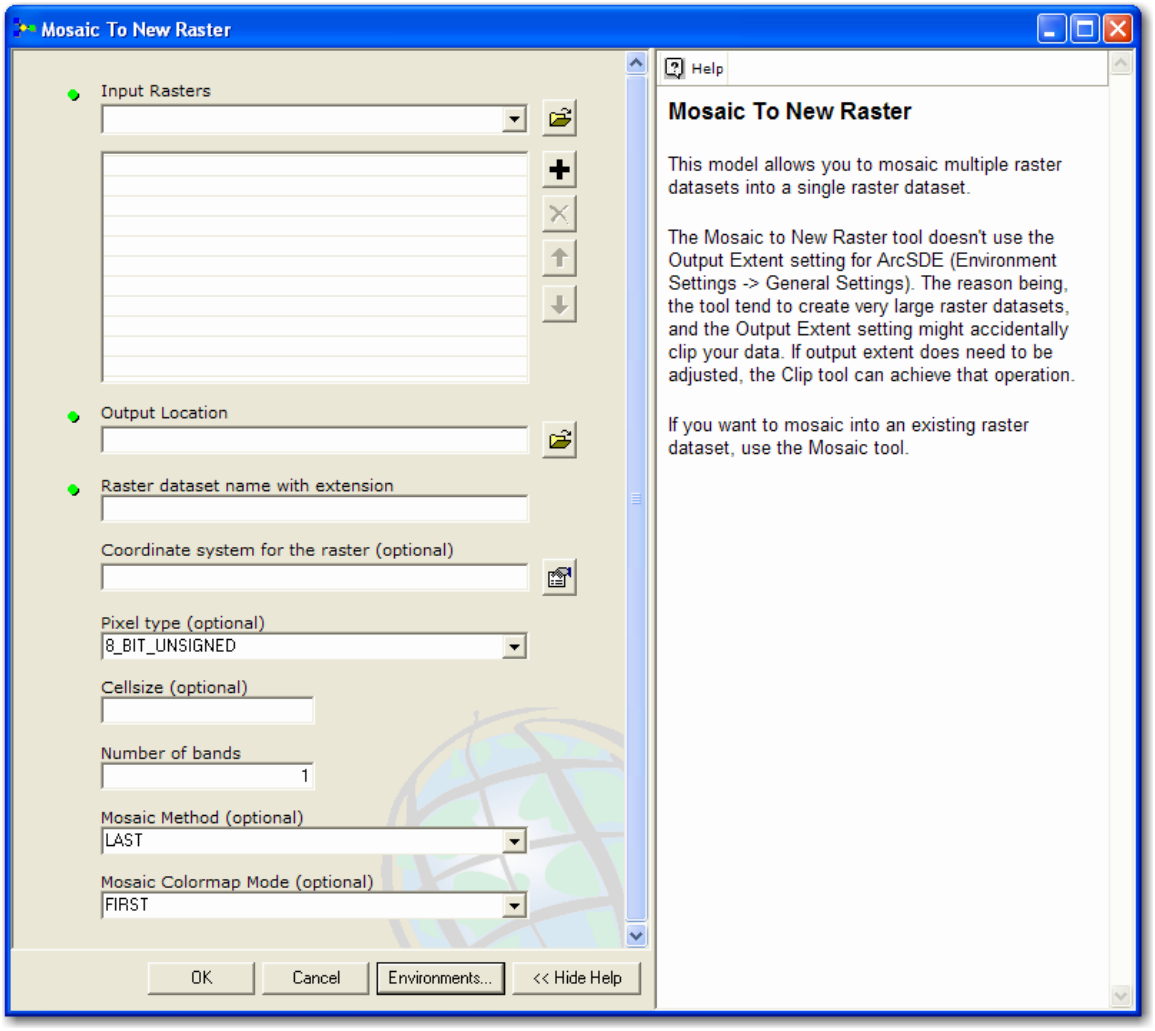
Discussion/Procedures

**Note: Cells need to be the same size. In this particular case cell size is not an issue but you want to make sure that you are working with the same type of data. Data being in different projections and folder could also be a problem. Datasets should be adjacent to each other. Also, keep in mind that even though you might be mosaicing or merging files, holes can still be present in your data. A fill *(sinks in a surface raster to remove small imperfections in the data*) option might be needed.

For the Mosaic option select on Toolbox>>Data Management Tools>>Raster>>Mosaic to New Raster.


ArcToolbox
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Coverage Tools
Data Management Tools
Database
Disconnected Editing
Domains
Feature class
Features
Fields
General
Generalization
Indexes
Joins
Layers and Table Views
Projections and Transformations
Raster
Batch Build Pyramids
Batch Calculate Statistics
Build Pyramids
Calculate Statistics
Clip
Composite Bands
Copy Raster
Copy Raster Catalog Items
Create Raster Catalog
Create Raster Dataset
Delete Raster Catalog Items
Mosaic
Mosaic To New Raster
Resample
Relationship Classes
Subtypes
Table
Topology
Versions
Workspace
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Network Analyst Tools
Samples
Spatial Analyst Tools

Select the adjacent files and save a location. Fields with a green dot next to them need to be addressed. All the other fields are optional.



Click “OK” to mosaic.